Letters to the Editor

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WIGNER QUARKS

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In both SU(6) and $\widetilde{U}(12)$ there occur redundancies (Beg *et al* 1964, Salam *et al.* 1965) which are not easy to interpret physically. For many reasons it seems attractive to analyse the case of non-strange baryons and mesons and consequently SU(4) the Wigner group in the static limit or $\widetilde{U}(8)$ in the dynamic model.

Let us consider SU(4) quarks (B = 1/3) then, the baryons are to be described by the (3, 0, 0) representation of dimension 20, exactly accommodating the non-strange baryon's which reciprocate in Chew's Bootstrap. These are $N_{\frac{1}{2}}$ and $N^*_{1/2}$. The mesons are quark antiquark compounds and are the members of

$$4 \otimes 4^* = 1 \oplus 15$$

The singlet is obviously η and the (31) accommodates π, ρ and ω. This ω may be endowed with the mean mass of ω and ϕ. The mass formula can be obtained easily and is for mesons

$$M^2 = M_0^2 + \alpha J(J+1) - \beta T(T+1)$$

which fits nicely with the mass values of the above mesons.

To consider the boot-strap one needs,

$$\begin{array}{cccccc} 20 \otimes & 15 = & 120 \oplus & 140 \oplus & 20 \ominus & 20' \\ (300) & (31) & (511) & (421) & (300) & (21) \end{array}$$

in which (300) occurs only once and is therefore free from coupling ambiguity (e.g. d-type, f-type in SU(3)). Our preliminary calculation (the details of which will be published else where) with Chew's Static model shows that (300) is self resonating (Signs of the elements in 4×4 crossing matrix).

The three Casimir operators are responsible for the simultaneous diagonalisation of Spin, Isospin and Magnetic moments of the baryons having wave functions ψ^{ABC} of (300) representations with $A = (a, \alpha)$, $B = (b, \beta)$ etc. and $a = 1, 2$; $\alpha = 1, 2$. Magnetic moment $\mu_3 = QS_3$ and

$$\psi_p = \sqrt{\frac{2}{3}}\ \psi^{11,\,11,\,22} - \frac{1}{\sqrt{3}}\ \psi^{11,\,21,\,12}$$

$$\psi_n = \sqrt{\frac{2}{3}}\ \psi^{21,\,21,\,12} - \frac{1}{\sqrt{3}}\ \psi^{11,\,21,\,22}$$

One should note that ψ^{ABC} are eigenvectors of μ_3 and $\phi = T_3\sigma_0 + \frac{B}{2} T_0\sigma_0$. This $\mu_n/\mu_p = -2/3$ very close to the experimental value.

If one calculates along the line of Rosen and Paksava (1964) one easily finds $g_A/g_v = -5/3$.

Extending this to $\widetilde{U}(8)$ similar to Salam's $\widetilde{U}(12)$ (Salam 1965) we find,

$$8 \otimes 8^* = 1 \oplus 63$$

and,
$$8 \otimes 8 \otimes 8 = 56 \oplus 120 \oplus 168 \oplus 168$$

We naturally take the mesons in 63 and baryons in 120. The occurrence of 5 and 10 dimensional Kemmer-Duffin matrices is a must. Also,

$$64 = 63+1 = 4\times 10+4\times 5+4$$

The last four being trivial.

One easily finds the contents of 120 as,

$$120 = (4,20)+(2,20)$$

and the Bargman-Wigner equations ensure that 4 with fully symmetric iso-indices describes a particle of Spin 3/2 and 2 describes a particle of Spin $\frac{1}{2}$. The form factors now come out with relative ease and lead to the expression of the magnetic moments,

$$\mu_p = \left\{1 + \frac{2m}{\mu}\right) \text{ and } \mu_n = -\frac{2}{3}\left(1 + \frac{2m}{\mu}\right.$$

where the numerical values are the same as in Salam (1965) which rest fully on the nonstrange particles.

Lastly the generator of the algebra of $\widetilde{U}(8)$ satisfy commutation relations which show that there exists a 32-component subalgebra and corresponds to the subgroup W(4) which again possesses the 16 parameter-subgroup U(4).

REFERENCES

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